

§13. Large Quasi-Coherent Modes Observed by a Heavy Ion Beam Probe on the JIPP T-IIU Tokamak

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We observed that in the potential measurement of a core region, the secondary beam energy measured by a parallel plate energy analyzer fluctuates with a very large amplitude (up to 100V) in the secondary beam of a HIBP on the JIPP T-IIU tokamak, similar to the observation carried out by TUI et al., in the TEXT HIBP¹⁾.. The frequency is around 10-40 kHz and the amplitude is 10 - 100 V. It is also found that the coherence of the energy change and the toroidal deflection is very high (0.6) implying that they are caused by the magnetic oscillations. Figure 1 shows typical time behaviours, those expanded views, and Fourier spectra of the sum of the secondary current, ND and toroidal shift. The sample volumes are at $r/a_p=0.5$. Since the conversion of ND to potential or beam energy is about 2 kV/ND in this case, the potential fluctuation or beam energy fluctuation in Fig. 1 is about 300 V_{p-p}. From Fourier spectrum of ND, we can observe that the oscillations with frequency less than 40 kHz are dominant in ND. We performed a few measurements to verify that these are indeed originated from the plasma turbulence.

The mode number of the oscillation in ND can be estimated to be $m=0$ since the phase shift of correlation analysis of ND of 5 sample volumes very small and the peak values of the correlation coefficient functions are almost 1.

Accordingly, we can conclude that these potential fluctuations are large-scale and quasi-coherent. In order to verify that these oscillations are not induced by several power supplies of high and low voltage in HIBP we have checked the influence of the ripple of all the HIBP power supplies. We concluded that these ripples are too small to explain the observed oscillations. In addition, we have verified that these oscillations are not observed when the plasma is replaced by the gas although we have obtained comparable detector currents in both cases.

We see in Fig. 1 that the observed oscillation in ND is found to correlates with the horizontal movement of the secondary beam at the detector, implying the high-frequency change of the poloidal magnetic field, since the horizontal deflection is only induced by the poloidal magnetic field. A parallel plate analyzer records the energy of the kinetic motion only in the analyzer plane (vertical and symmetry plane), eV_0 out of the total energy (eV_t). We performed the potential measurement rotating the energy analyzer horizontally along the vertical axis with a fixed point of the middle of entrance slit of the analyzer. Since the phase of the toroidal motions and the energy in the coherence analysis do not change in these series of the experiments, we can conclude that the ND oscillation is not due to the horizontal deflection. The large fluctuations in ND can be ascribed to the local potential change at the sample volume or the acceleration by the change of the magnetic field.

Reference

1) H. Y. W. Tsui et al., Phys. Fluids B 5, 1274 (1993).

Fig. 1 Typical time behaviours, those expanded views, and Fourier spectra of the sum, ND and toroidal shift.

